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(54) VALVE ACTUATOR

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No. OF CLAIMS 3

BACKGROUND OF THE INVENTION

1. Field of the Invention:

The present invention relates to control of a valve spring-urged to one of its two positions. More specifically, the invention relates to manual override of the spring force until an automatic system takes command to maintain the valve into one of its two positions.

2. Description of the Prior Art:

U.S. Patent 3,094,146, issued June 18, 1963, to Clarence O. Glasgow, discloses a system for actuating a fluid pressure valve from one to the other of two positions. The valve actuated is, specifically, that disclosed in U.S. Patent 2,860,660, issued November 18, 1958, to Swatsworth.

The system disclosed responds to a variable, such as temperature or pressure, transduced into a mechanical motion which is applied directly to shift the Swatsworth valve to one of the alternate positions against spring force. At the "start-up" of the system, the valve is positioned to one of the positions, by spring force. If the procedure at start-up requires the valve to be in the other of the positions, the valve must be manually moved to the alternate position against the force of the spring. When the variable transduced is at its normal, or running, value, the transducer will hold the valve in the alternate position against the spring force.

There has been a problem of longstanding in operating this system. The valve can be manually held in the alternate position against spring force, but how do you hold it there until the transducer takes over with the "running" value of the variable? Instructions to manually hold the valve in the alternate position have been violated by operators who will not

take time. Such operators have propped a stick or a rock against the valve actuator to overcome the spring force. Such permanent obstruction can create a dangerous situation upon shutdown of the system. 'The permanent prop left by a careless, or irresponsible, operator keeps the valve in the alternate position when the transducer would normally permit the spring force to return the valve to its first position.

The problem is more complicated when sealed housings for the system are required. If the lazy operator cannot gain ready access to the mechanism, he will quite likely rupture the weather-proof seal to carry out his objective.

What is needed, and has been needed for some time, is a temporary mechanical prop for the valve which will be automatically removed when normal, running values sensed by the transducer are reached. More specifically, what is needed is a prop which will be placed in position by the operator with a manually operated mechanism, yet will be removed automatically when the variable sensed reaches a predetermined value.

A re-reading of the foregoing statement of the problem makes it sound unnecessarily complicated. What is needed is a simple temporary prop for a two-position, spring-actuated, valve normally held in one of the positions by a transducer responding to the normal value of a variable. That is one way of putting the problem into one sentence.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a manually operated mechanical linkage to hold the operator of a two-position valve in one of the two positions against spring force.

It is another object to automatically remove a mechanical linkage which is manually positioned to hold the valve operator in one of two positions against a spring force until a variable

sensed by the operator reaches a predetermined value.

The present invention contemplates manually moving a cam against the operator of a two-position valve to thereby force the operator to one of its two positions against the opposing force of a spring. The cam is shaped to lock into its holding position against the valve actuator and to be released only upon the transducer responding to a predetermined range of values of the variable, thereby substituting the transducer for the cam. Upon release, the cam moves to its initial, inoperative position.

Other objects, advantages and features of this invention will become apparent to one skilled in the art upon consideration of the written specification, appended claims, and attached drawings, wherein;

Fig. 1 is a schematic illustration of a safety shutdown system for the pilot light of a burner in which the present invention is embodied;

Fig. 2 is a partially sectioned front elevation of the two-position valve of the Fig. 1 system in its second position;

Fig. 2a is an isometric view of the shuttle element and valve seats of the two-position valve;

Fig. 3 is an isometric view of the two-position valve of Fig. 2 in its first position;

Fig. 4 is a partially sectioned side elevation of a valve similar to Fig. 1; and

Fig. 5 is an exploded isometric view of part of the structure of Fig. 4.

THE SYSTEM OF FIG. 1

Referring specifically to FIG. 1, a representation of a complete system is shown in which the present invention is embodied. A furnace wall is represented at 10. This

furnace represents various spaces which it is desired to heat by burning fuel. A burner tube 11 is mounted in the wall 10. A burner front 12 closes the end of tube 11 and supports a burner structure 13 within the tube. Burner 13 functions to mix air, and the fuel supplied through conduit 14, for the propagation of a flame within tube 11. The heat supplied the furnace by the flame propagated from the burner in the tube is detected by a temperature responsive element 15.

Temperature responsive element 15 is used to generate a control signal by any of several well known devices represented at 16. The output of transmitter 16 is indicated as a fluid pressure applied to the modulation of main fuel valve 17.

Burner 13 may be operated intermittently. During the periods the burner is shut down, it is generally desired to maintain a pilot light. Therefore, pilot light structure 20 represents a source of continuous flame near the end of burner 13. In the system disclosed, pilot light 20 is supplied gas directly from fuel conduit 14 by conduit 21.

If pilot light 20 should go out, it is logical to assume that main burner 13 is also out. While both of these burners are out, it is desired that the supply of fuel to both burner 13 and pilot light 20 be cut off. Otherwise, the fuel entering burner tube 11 would be an explosion hazard. Therefore, the present invention provides a system to continuously respond to the heat, as a variable condition, at pilot light 20. Should this pilot light go out, the system provides for valve 22 to shut off the main supply of fuel to burner 13 through conduit 14 and for the isolation of fuel from the pilot light.

In general, the system provides for a part of the

main gas supply in conduit 14 to be drawn off by the conduit 24 through a three-way, two-position, snap-acting, mechanically-actuated, fluid pressure control valve within housing 23. This drawn-off portion of the main gas supply is taken from conduit 24 and into conduit 25 through the control valve mounted within 23. Pilot light conduit 21 is branched from conduit 25. Conduit 25 also applies the drawn-off portion of the fuel gas as a pressure with which to maintain shut-down valve 22 open as long as pilot light 22 is propagating its flame.

To actuate the control valve mounted within housing 23, a transducer is provided to convert the variable condition of pilot light heat into mechanical motion. The mechanical motion is transmitted by linkage in housing 23 to actuate the control valve mounted therein. The primary element of the transducer is indicated at 26 as a bulb, connected by a capillary pipe 27 to a receiver of the transducer mounted on housing 23. The transducer system, including the bulb, capillary and receiver, is filled with a fluid, usually mercury, which will expand when the heat of the pilot light flame is applied to bulb 26. The force generated by this expanding mercury moves a transducer element in a substantially linear path. The linkage between this movable transducer element and the control valve in housing 23 actuates the valve to connect conduit 25 to either the gas conduit 24 or exhaust.

OPERATION OF THE FIG. 1 SYSTEM

With both the pilot light and main burner out, the control valve in housing 23 is positioned to block the fuel supply of conduit 24 from conduit 25. Therefore, valve 22 will isolate the main gas supply from burner 13.

Blocking valve 28 should now be manually closed and

manual plunger 29 depressed to actuate the valve in housing 23 so conduits 24 and 25 will be connected. Fuel will reach pilot light 20 through conduit 21 which can then be lit by hand.

As bulb 26 responds to the heat of the pilot light flame, the mechanical movement generated by the transducer system will position the control valve of housing 23 to maintain conduits 24 and 25 connected after plunger 29 is released. With pilot light 20 propagating a flame, blocking valve 28 may be opened and burner 13 will light from pilot light 20. As the temperature in the furnace rises from the heat produced by burner 13, temperature responsive element 15 senses the temperature and regulates the main fuel valve 17 in accordance with the setpoint value predetermined by transmitter 16.

HOUSING 23 MECHANISM

The housing 23 contains a mechanism which includes a three-way, two-position, snap-acting, mechanically-positioned, fluid pressure valve 30 mounted in fixed relation to the transduction system so the mechanical motion produced by the transduction system will be directly applied to the actuating element of the valve. The control valve 30 has two, alternate, positions. The transduction system produces a substantially linear motion along a fixed path. The system of FIG. 1 is arranged to indicate that an increase in temperature at pilot light 20 produces a motion which leaves the control valve in one of its two predetermined positions. In the position shown in FIG. 2, the control valve connects conduit 25 to exhaust and blocks conduit 24. An increase in temperature at pilot light 20 produces the alternate motion of the transducer which leaves the control valve free to be returned to the first of its two positions.

In the first position, the valve connects conduits 24 and 25 and blocks both conduits from the exhaust so no fuel gas is lost from the system during normal, or running, operation.

It is generally desired to manually reset the control valve from either of its two positions to the alternate position. Additionally, it is desired that a convenient means be provided with which to predetermine the degree of heat which will actuate the control valve to either of its alternate positions. The present invention provides all these functions with parts that are simple, rugged, readily assembled and easily adjusted.

Referring more specifically to FIG. 2, the housing 23 interior is disclosed in greater detail. The cover with which the housing 23 is normally provided has been removed and sections taken of the housing and parts to illustrate their functions to better advantage.

The control valve 30 is mounted directly on the housing 23 by bolts. The control valve, as illustrated, can be readily compared to the disclosure of Swatsworth 2,860,660. The snap-acting mechanism disclosed in that patent is incorporated in the control valve 30. The shuttle 31 is alternately snapped into position on seats 32 and 33 by actuation stem 34. In positioning on seats 32 and 33, shuttle 31 effectively blocks passage of gas through the seats.

FIG. 2A shows the arrangement of the stem 34, yoke 34C, spring 34D and shuttle 31 to greater advantage. As set forth in Swatsworth 2,860,660, yoke 34C is in the form of a thin plate. Any known means such as the slot 34A in the end of stem 34 may be used to engage the top of the yoke 34C. In the bottom of the yoke is a slot 34B designed to straddle

opposite sides of the circumferential recess formed in shuttle 31. Around the slot engaged ends of the stem and yoke is a tension spring 34D, the convolutions of which surround the slot engaged ends of the yoke and the stem to give mechanical support to their engagement. Any known means may be used for fastening one end of the spring to the stem above the slot engagement and the opposite end of the yoke.

As valve stem 34 is pivoted about 41, the spring 34D develops a force transverse the axis of the stem 34. This transverse force is directed to carrying the shuttle 31, attached to the lower end of yoke 34C in slot 34B, against seat 32 or seat 33.

As heretofore described, the transducer is assumed to be in the position it takes when the pilot light 20 is out. The transducer is at one extreme limit of its range of mechanical travel over its fixed path. Stem 34 has been carried to the second of its two positions by the transducer. Shuttle 31 is seated on 32, isolating the gas of conduit 24 from conduit 25. Correspondingly, conduit 25 is connected to exhaust through seat 33. Main shutdown valve 22 is closed by its spring and no fuel gas is supplied burner 13 or pilot 20.

In Fig. 2, stem 34 can be returned to the first of its two positions by cooperation of plunger 29 and cam 50. Plunger 29 is slidingly mounted in hole 29A and urged outward by a spring until a key on its shaft limits the outward travel. The spring force is manually overcome by depressing plunger 29 until it contacts and rotates cam 50 into engagement with stem 34. Sufficient manual force on the linkage comprising plunger 29-cam 50 will shift the stem 34 and snap shuttle 31 to its seat on 33. Gas will then flow from conduit 14, through conduit 24 and into conduit 25.

The result will be an opening of main shut-down valve 22 and a supply of fuel for pilot burner 20. This will be referred to as the normal, or running, operation of the system.

The three-way, snap-acting, two-position, fluid pressure control valve 30 is a simple, rugged, dependable means of selecting which of two fluid pressures will be its output. With a fluid pressure output, a large degree of flexibility for these safety systems is obtained. As an example, a number of burners can be interconnected readily. The burners could have their pilot supply conduits tied together. Failure of one of the pilots would shut down all the burners. Many other interconnections of several systems are made possible by the flexibility of using a valve such as 30 to directly control fuel gas supplied the pilot burner as fuel and the main shut-down valve as an actuating force.

The transducer has been considered from bulb 26 to housing 23. More specifically, the mercury acts on a piston in housing 35 and plunger 36 is reciprocated along a vertical path within housing 23. It is the movement of this plunger 36 which is used directly to actuate control valve 30.

Control valve 30 has been considered from its mounting within housing 23 with fixed relation to the path over which plunger 36 moves. A linkage system extends between plunger 36 and valve stem 34 to complete the transduction and achieve the result of positioning the shuttle 31 between seat 32 and seat 33.

The linkage system centers around lever 40. FIGS. 2 and 3 should be considered together to gain the best appreciation of the shape of member 40 as a lever. Lever 40 is distinctively shaped and it may be somewhat difficult to gather, from a consideration of FIG. 2 only, the fact that 40 is basically a

lever, pivoted at 41. A simple threaded bolt defines pivot point 41, and the bolt extends through lever 40 to mount in a hole of the body of control valve 30.

A spring 42 is attached to the valve body and the lever 40 in order to urge lever 40 to pivot clockwise (CW) about pivot 41. Plunger 36 of the transducer applies a force at swivel pivot 43 to rotate lever 40 counterclockwise (CCW) against the force of spring 42. To specifically transmit the force of plunger 36 to swivel pivot 43, plunger 36 depends into a socket of sleeve link 44. Sleeve 44 is threaded on link 45. Thus, the range of vertical travel of plunger 36 is adjusted with respect to the range of travel of swivel point 43. As point 43 travels in a slight arc about pivot 41, the swivel at pivot 43 is desirable in order to convert the vertical motion into the circular motion. Sleeve 44 is readily rotated to adjust it from the holes 46 by utilizing a simple tool.

The linkage is completed by contact pin 47 threadedly mounted in hole 47A in lever 40. Pin 47 is mounted at a right angle to the parallel planes in which plunger 36 and valve stem 34 move. Properly positioned in this right angle plane, as indicated in both FIGS. 2 and 3, pin 47 directly contacts valve stem 34 as lever 40 pivots CW about pivot 41. This direct contact and resulting snap of shuttle 31 onto seat 32, is illustrated as having taken place in FIGS. 2 and 3. The condition of no flame propagation which produces this particular position of valve 30 has been discussed.

Valve stem 34 may now be returned to its first position by plunger 29 and cam 50. In so moving, stem 34 will rotate lever 40 CCW. The socket engagement between plunger 36 and sleeve link 44 permits the linkage to be moved without disturbance

of the transducer. When the heat of the pilot burner flame causes plunger 36 to move downward far enough, the plunger will positively contact the socket of link 44 and hold lever 40 against CW rotation by the force of spring 42.

CAM 50

The present invention is centered around the concept of cam 50 as a prop for valve stem 34. Heretofore, plunger 29 and cam 50 have been merely disclosed as a linkage with which stem 34 has been moved to its first position manually. When the pilot light goes out, the plunger 36 travels upward and spring 42 moves stem 34 to its second position.

Now let us go back over the start-up procedure again. This time, we can make a summary analysis of the operation. We want to send fuel gas to the pilot light, so we want to put the stem 34 in its so-called first position.

Plunger 29-cam 50 move stem 34 to its first position. Also, cam 50 is shaped to lock stem 34 in its first position. Fig. 3 shows cam 50 positioned (rotated CW) until projection 51 rides up and over the upper tip of stem 34. Spring 42 applies a clockwise force to rotate lever 40 and this force is transmitted to stem 34 through contact pin 47. The result is that cam 50 is locked in the Fig. 3 (first) position, against stem 34.

Now for the automatic resetting. Stem 34 can move a small distance to the left as viewed in Fig. 3 position, if lever 40 and pin 47 are rotated CCW a small degree. The travel of plunger 36 is arranged, relative to the socket of sleeve link 44, to provide this small CCW rotation of pin 47 when bulb 26 reaches the "running" temperature at pilot light 20. The slope of protuberance 51 on cam 50, and the torque of

return spring 52, combine to create a vector of force which moves stem 34 to the left as pin 47 rotates CCW. When the normal, or "running", condition has been reached, this movement has progressed so far that stem 34 has been removed from beneath protuberance 51. There are other cam shapes which will provide a locking means, and not all such shapes will embody an obvious protuberance such as 51. Other cam shapes will, however, provide the function of protuberance 51 by a suitable arrangement of the slope of the cam and the location of the cam axis of rotation. One such alternate shape would provide a cam wherein the face which comes in contact with stem 34 in the locking position, is flat and has a slope which is equal to the slope of stem 34 in the locked position. As always in cam design, the final shape will be determined by the force vectors involved and by the art of the designer. Without the support of protuberance 51, cam 50 returns to its Fig. 2 position under the influence of spring 52. Therefore, the cam 50, as a prop for stem 34, is automatically removed when the pilot light raises the temperature of bulb 26 to a normal range. Cam 50 then offers no obstruction to the subsequent return of stem 34 to its second position, if and when the pilot light subsequently goes out.

In summation, the operator is now provided a mechanism with which to manually operate the two-position, three-way valve at start-up. The valve, urged toward one position by a spring, is mechanically propped in the alternate position by a linkage characterized by a cam. Then, when the system reaches its normally operative, or running, condition, the cam is released for automatic return to its initial position. The invention is obviously useful in reducing human error in

operation of many systems using this type of valve.

Figs. 2 and 3 disclose the adaptation of the invention to the structure disclosed specifically in Patent 3,094,146. However, in actually reducing a commercial embodiment of the invention to practice, the forms of Figs. 4 and 5 have evolved. Essentially, the cam shaft of Figs. 2 and 3 is extended through the case as part of the linkage with which to manually position the cam.

In Figs. 4 and 5, case 60 is comparable to case 23 of Fig. 1. Valve 61 compares with valve 30 and is bolted into position within case 60. Lever 62, spring 63, pin 64 and temperature element 65 all cooperate with stem 66 as do comparable elements in the preceding drawings. Cam 67 locks stem 66 into the first position of Fig. 5 just as cam 50 performs in Fig. 3. Cam 67 is also returned to its reset position by spring 68 exactly as spring 52 functions in Fig. 3.

However, Figs. 4 and 5 distinguish from the prior structure in the linkage with which cam 67 is manually positioned. The shaft 69, for cam 67, is extended to outside case 60 and, in effect, substitutes for push rod 29.

Shaft 69 can be extended through the back of case 60. However, it is presently preferable to extend it through cover 70 on the front of housing 60. A knob 71 is mounted on the end of shaft 69 extending out of cover 70 and legends provided for its two positions.

Cam 67 and, consequently, shaft 69, and knob-pointer 71, are shown in the first position. The stem 66 is propped, locked, or held in the first position by cam 67.

When the temperature responsive system 65 is brought

up to the normal, or running, range, cam 67 is released to return to the run position. This embodiment of Figs. 4 and 5 operates in the same way as the embodiment of Figs. 2 and 3.

From the foregoing it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth, together with other advantages which are obvious and inherent to the apparatus.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the invention.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted in an illustrative and not in a limiting sense.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. Linkage connected to actuate a two-position valve having a stem, including,

a lever arranged to pivot against the valve stem which, by moving from a first to a second position, moves the stem from a first position to a second position,

a first spring connected to the lever to move the lever and stem to their second positions,

a means arranged and responsive to a variable condition so that when the condition is within a predetermined range, the means will bear against the lever and prevent the lever moving under the force of the first spring to move the valve stem from the first to the second position,

a cam arranged to be manually brought into engagement with the valve stem and move it to the first position, the cam being shaped and engaged by the valve stem to releasably maintain the stem in the first position until the cam and stem are released from each other by the means responsive to the variable condition,

and a second spring connected to the cam to return the cam to its original position after the release.

2. The linkage of claim 1 wherein,

there is a protuberance of the cam, which is positioned to engage the valve stem to maintain the valve stem in the first of its two positions.

3. The linkage of claim 2 wherein,

the second spring is connected to the cam to rotate the cam to its original position upon release of the valve stem from the cam protuberance by the means responsive to the variable.

VALVE ACTUATOR

ABSTRACT OF THE DISCLOSURE

A two-position valve is connected to a temperature sensitive element through a linkage system which is manually positioned to actuate the valve to one of the positions, held in the one position by the temperature element responding to a normal range of temperatures, and through which the valve is actuated to the alternate position when the temperature leaves its normal range.

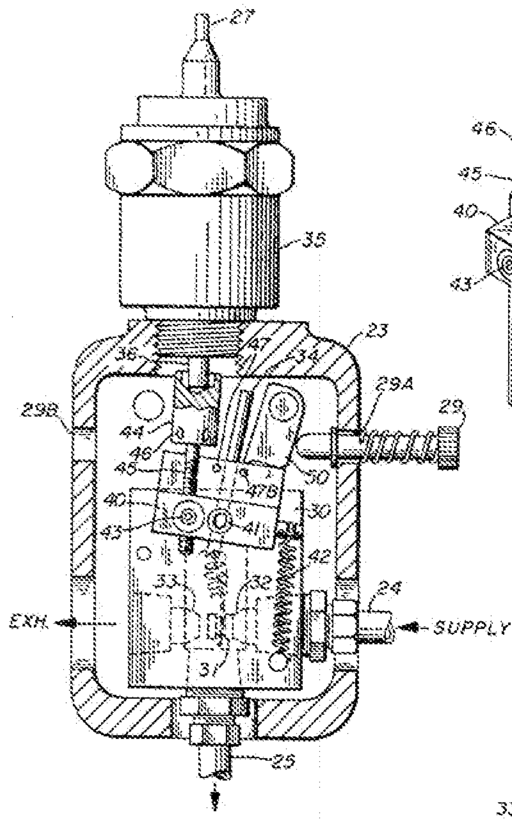

Fig. 2.

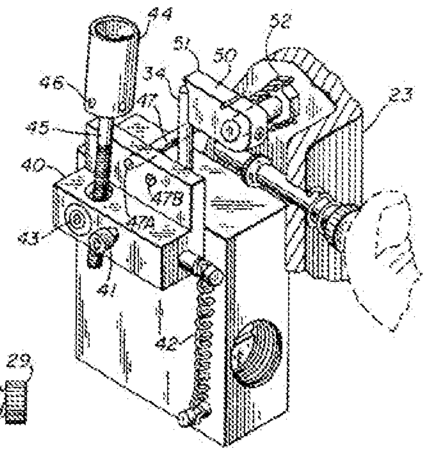

Fig. 3.

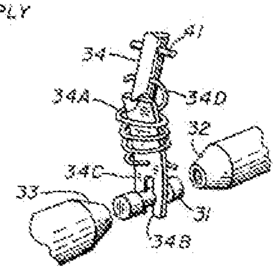

Fig. 2a.

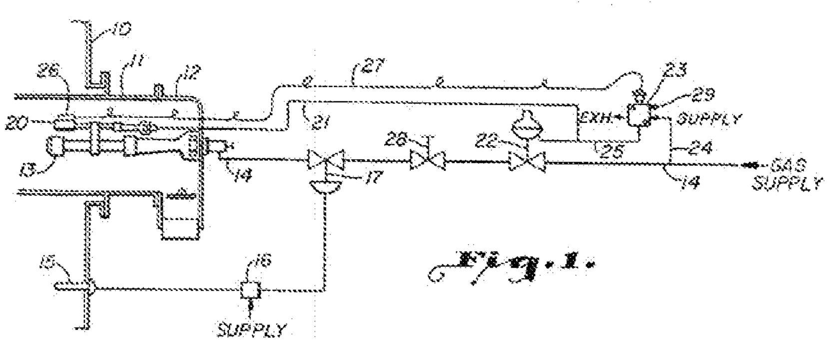

Fig. 1.

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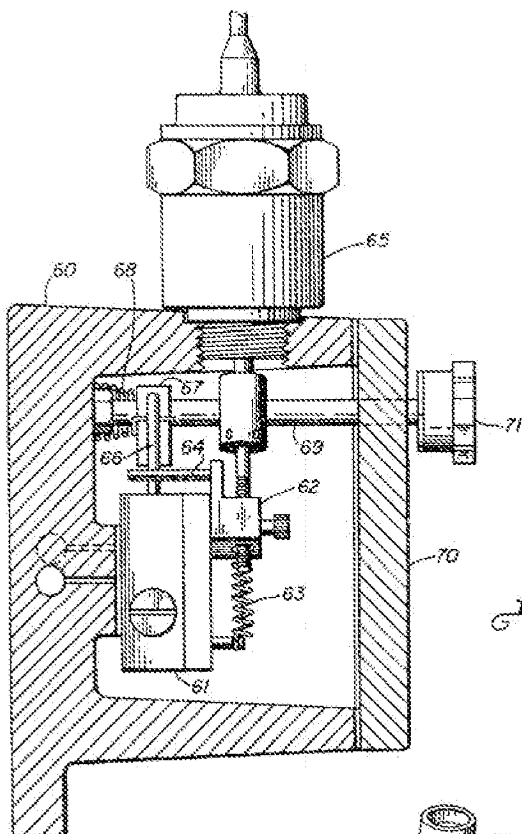

Fig. 4.

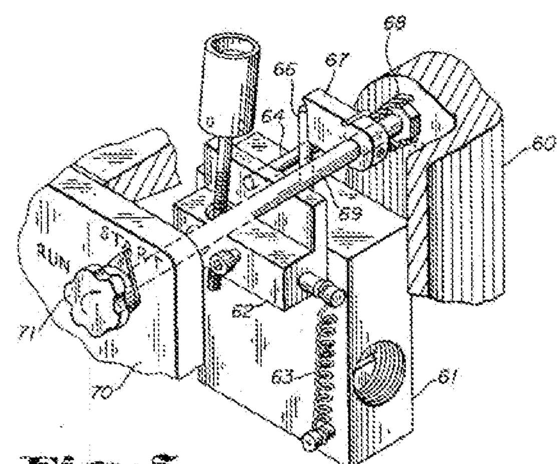

Fig. 5.

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